Fuel Demand Prediction for Regional Hurricane Evacuation in Louisiana

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- Motivation
  - LA-DNR Fuel Team requires visibility on fuel requirements & available capacity to minimize fuel related emergencies

- Past Experience
  - Texas: Hurricane Rita
  - Louisiana: Hurricane Gustav & Ike
    - Fuel demand increased by 400%
    - Allocation of Generators
    - Challenges identifying fuel outages

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- Provide fuel demand, fuel deficit and evacuation traffic estimates along various evacuation highways during hurricane evacuation(s)
  - Estimated Traffic, fuel demand and available fuel in GIS Maps
  - Data for a 5 –day period including the day of landfall and 4 days prior to landfall
  - In 6-hour intervals
  - Interstates & state highways
  - Data specific to track & evacuation scenario

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- Inform gas station owners about the expected fuel demand
  - Helps them plan and schedule deliveries ahead of time
- Inform distributors & Bulk suppliers
  - Visibility on areas that are likely to have fuel outages
- Emergency fuel supply
  - Positioning/scheduling emergency fuel in areas that are likely to have fuel outages

1. Evacuee Behavior Study
   - Develop a evacuee behavior model based on historical preferences, i.e. when, where and how they evacuated for various hurricanes

2. Generate Origin Destination matrices
   - Generate origins and destinations matrices based on where people evacuate from and where they will evacuate

3. Predict Evacuee Traffic using Transportation-based Evacuation Model
   - Use the evacuee behavior parameters and the evacuation transportation network configuration to forecast evacuation traffic

4. Estimate Fuel Demand & Deficit
   - Translate evacuation traffic to fuel demand based on the total number of vehicles that will stop for gas at each gas station
   - Estimate fuel deficit based on the difference between the available fuel capacity and demand

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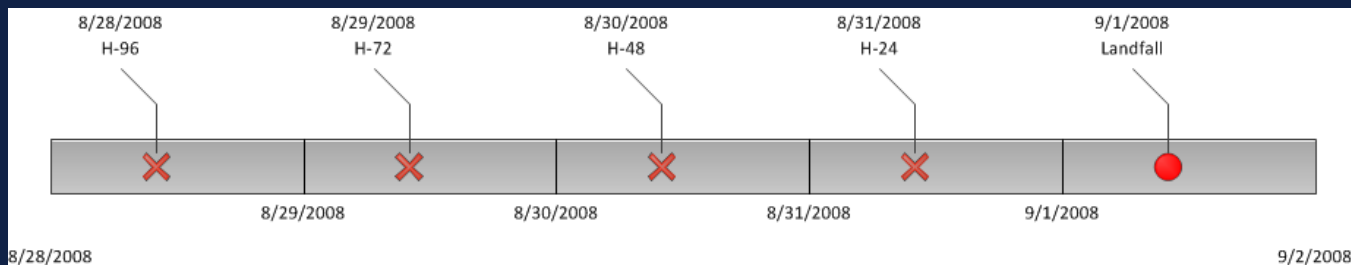
Work product description

- Interactive GIS Map
  - Zoom in, zoom out
  - Select a particular segment to see the actual numbers
  - Time slider to know the evacuation traffic & fuel results at various times
  - Chart to understand the trends over the five day period

- Shows the following layers
  - Evacuation Traffic, Fuel Demand, Fuel Availability
  - Gas stations
  - Hurricane Track
  - Evacuation Orders for various parishes
  - Contraflow, Road closures & DOTD Traffic cameras

- A printable map
  - For demonstrating this product to the UCG meeting

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Demonstration

- http://sonris-www.dnr.state.la.us/gis/fst/map/

- LA-DNR
  - Initiates a request for the work product
  - GIS Team provides hurricane track from NOAA, evacuating orders from the LSP, Traffic updates from LA-DOTD
    - As needed and updated by NOAA, LSP and LA-DOTD
- NIMSAT Institute
  - Observes the track, contraflow orders, road closures, evacuation orders to determine the best possible scenario
  - Runs the model
  - Publishes the fuel demand, fuel availability & traffic estimates
  - Provides model results once every 24 hours

8/28/2008 H-96	8/29/2008 H-72	8/30/2008 H-48	8/31/2008 H-24	9/1/2008 Landfall
✗	✗	✗	✗	●

8/28/2008   8/29/2008   8/30/2008   8/31/2008   9/1/2008   9/2/2008

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Limitations

- Results are estimates
  - Traffic estimates are +/- 27% on the average
  - Observations on fuel data are not available
- Some key assumptions
  - For estimating fuel deficit (or availability), gas stations are assumed to be operating at 60% capacity 4 days prior to landfall and no refueling happens
  - We have accurate gas station storage data for 575 gas stations (out of 2670 stations)
  - Vehicles fill up 16 gallons of fuel when they stop for fuel
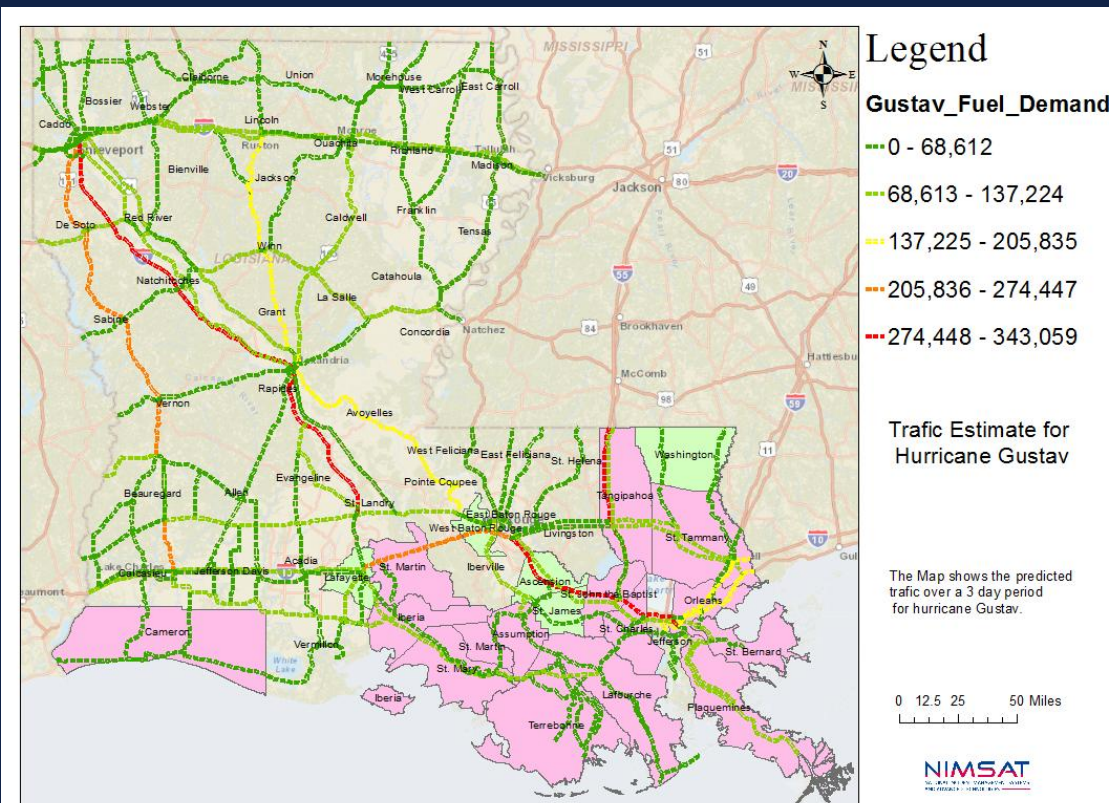
Acknowledgements

- LA-DNR:
  - Sara Krupa, Stephen Chustz, Dallas Shearer
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  - Dr. Xiaoduan Sun

Thank you

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- Areas with highest Fuel Demand
  - I-49 -Alexandria to Shreveport
  - I-49 -Lafayette to Alexandria
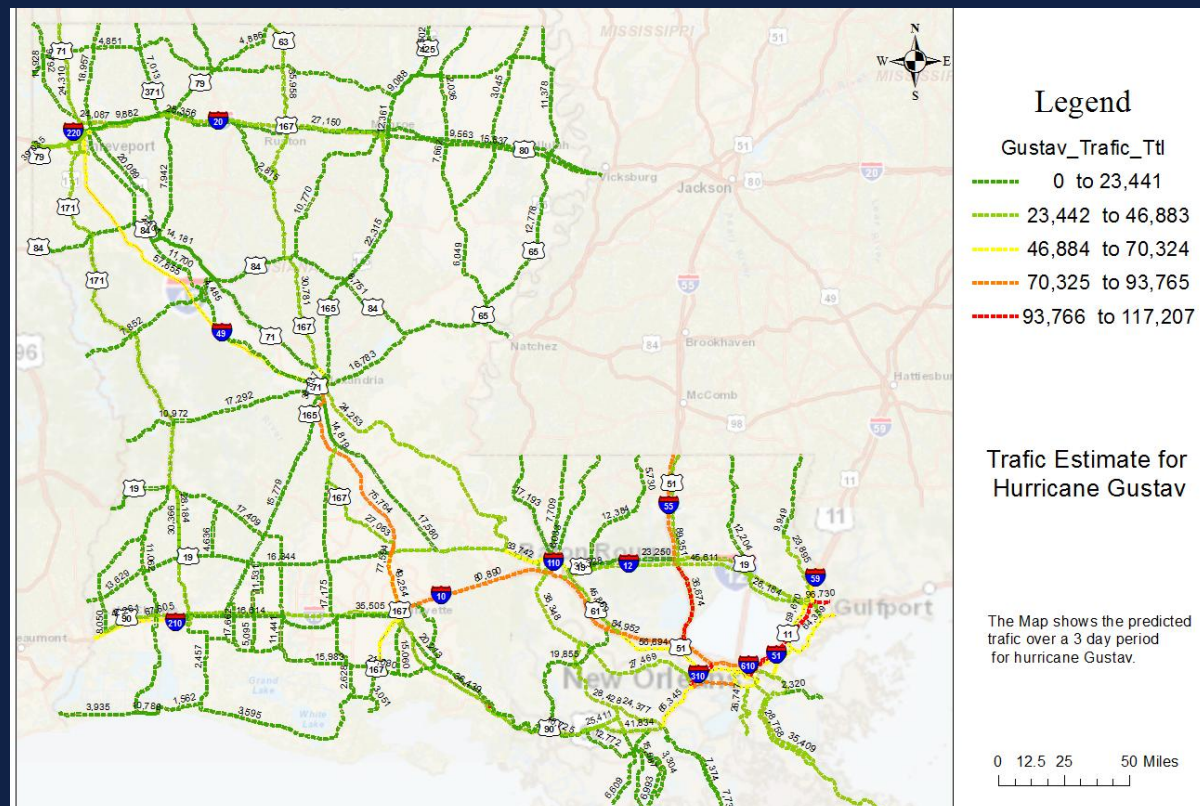 - I-10 -New Orleans to 10-12 split
  - I-55 N (to Jackson)

Legend

Gustav_Fuel_Demand
- 0 - 68,612
- 68,613 - 137,224
- 137,225 - 205,835
- 205,836 - 274,447
- 274,448 - 343,059

Trafic Estimate for Hurricane Gustav

The Map shows the predicted trafic over a 3 day period for hurricane Gustav.

0 12.5 25   50 Miles

| HURRICANE GUSTAV | | | | | FUEL DEMAND | | | | | | | | | | | | TOTAL |
| | | | | | T-96 to T-72 | | | | T-72 to T-48 | | | | T-48 to T-24 | | | | |
RNO	LEN	ROUTE_DESC	NO G	Traffic	D3_N	D3_E	D3_A	D3_M	D2_N	D2_E	D2_A	D2_M	D1_N	D1_E	D1_A	D1_M	
I-0049	121	I-49 -Alexandria to Shreveport	30	57,655	3,078	5,197	9,726	18,334	12,039	22,287	41,689	78,601	12,883	21,758	40,712	76,755	343,059
I-0049	85	I-49 -Lafayette to Alexandria	46	75,764	2,846	4,800	8,981	16,934	11,119	20,582	38,502	72,592	11,895	20,096	37,597	70,885	316,829

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- Highways with maximum Traffic

  - I-310 (US-90 to US-61 to I-10) After Kenner

  - I-10 (New Orleans to Eastern State Line going to MS)

  - I-610 (New Orleans)

  - I-10 (New Orleans to 10-12 split)

  - I-10 (10-12 split to Lafayette)

Legend

Gustav_Trafic_Ttl

- – – – 0 to 23,441
- – – – 23,442 to 46,883
- – – – 46,884 to 70,324
- – – – 70,325 to 93,765
- – – – 93,766 to 117,207

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HURRICANE GUSTAV					TRAFFIC OVER A 3-DAY PERIOD											
					T-96 to T-72				T-72 to T-48				T-48 to T-24			
RNO	LEN	ROUTE_DESC	NOG	Traffic	D3_N	D3_E	D3_A	D3_M	D2_N	D2_E	D2_A	D2_M	D1_N	D1_E	D1_A	D1_M
I-0049	121	I-49 -Alexandria to Shreveport	30	57,655	507	856	1602	3020	1983	3671	6867	12947	2122	3584	6706	12643
I-0049	85	I-49 -Lafayette to Alexandria	667	1125	2105	3969	2606	4824	9024	17014	2788	4710	8812	667	1125	2105

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NATIONAL INCIDENT MANAGEMENT SYSTEMS AND ADVANCED TECHNOLOGIES
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- Assumptions
  - Operating at 75% cap
- Highways with maximum fuel deficit
  - I-55 North to Jackson
  - I-49 Alexandria to Shv
  - US-90 LA-1 to Morgan City
  - US-79
  - LA 3127 (Shreveport)

Legend

Gustav_Fuel_Deficit

- -10,978 - 66,222
- 66,223 - 190,274
- 190,275 - 347,207
- 347,208 - 526,559
- 526,560 - 4,355,584

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